

DISCOID HEADS: AN INHERITABLE TRAIT  
IN *CHRYSANTHEMUM LEUCANTHEMUM* L.

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In the spring of 1976, a plant of *Chrysanthemum leucanthemum* L., Ox-eyed daisy, was found growing on disturbed ground in Durham, New Hampshire. This was a robust plant with numerous heads, all of which lacked the normal white ray florets and consisted only of yellow disc florets. Many other plants of this species growing in the same disturbed area were all normal, with numerous white ray florets in each head.

The heads of the anomalous plant were all mature or nearly so, and a few had shattered and shed their seed. The heads had presumably been open-pollinated with numerous surrounding normal radiate plants. A search of the entire area turned up no other rayless plants. During the search, however, a few heads were discovered that appeared rayless or partially so at first glance, but closer examination revealed that the white rays had been harvested by some foraging insect, perhaps as food. Haber (1980) reports such foraging on the disc and ray florets of the Flat-topped white aster, *Aster umbellatus*, by the Broad-winged Bush-katydid, *Scudderia pistillata*, near Ottawa, Ontario, Canada. I have not yet been able to find an insect in the act of foraging, despite searches through various populations of flowering *C. leucanthemum* showing evidence of such activity.

Notes in some taxonomic descriptions of *Chrysanthemum leucanthemum* indicate that a condition such as this may have been noted previously. *Gray's Manual* (Fernald, 1950) notes parenthetically that rays may be "rarely tubular, laciniate or deformed" for the typical variety, and that a "Forma *tubuliflorum* Hendrikssen (tubular-flowered) has tubular ligules" under var. *pinnatifidum* Lecoq, & Lamotte. Similarly, in the *Flora Europaeae*, Heywood (1976, as *Leucanthemum vulgare* Lam.) notes that ligules may be "rarely very short or absent." Self-incompatibility or slight self-compatibility is noted for a number of species of *Chrysanthemum* by Fryxell (1957), but I have found no references to indicate

research on the breeding system or inheritance of discoidy in the species, or that hybridization between naturally occurring discoid and radiate types may have given rise to plants with short rays, such as those noted by Heywood. Some closely related species of *Chrysanthemum* such as *C. Balsamita* L., or related genera, such as *Tanacetum* L., have both radiate and discoid forms, or show varying degrees of ray reduction.

A similar genetically controlled discoid condition in normally radiate taxa has been demonstrated in such genera as *Bidens pilosa* L., tribe Heliantheae (Rajan, 1977); *Senecio vulgaris* L. and *S. squalidus* L., tribe Senecioneae (Ingram & Taylor, 1982); and *Layia glandulosa* (Hook.) H. & A. (Clausen, Keck, & Heisey, 1947), tribe Heliantheae, among others (see Burtt, 1977). In these genera it has been shown that hybridization between normal radiate plants and spontaneous mutant discoid plants have given rise to hybrid intermediates that bridge the gap between the two extreme forms. This has not been shown to have occurred, as yet, in *Chrysanthemum leucanthemum*.

To determine whether the discoid condition was a heritable trait, and to develop a population of plants for experimental work, seed from the original plant were germinated in the University of New Hampshire greenhouses. Of 120 second generation progeny recovered, two eventually proved to be discoid. The first progeny began to flower in the late spring of 1978. Of these, one plant was discoid, bearing a single head, the other plants were radiate. At the time of the discovery, three or four rows of peripheral florets had opened in its discoid head and were subject to open pollination with nearby radiate siblings by random insect visitors having access to the greenhouse through the ventilation louvres. The plant was isolated in a screen enclosed pollination cage that excluded any pollinators, so that the more central florets were presumably selfed. However, it was not possible to distinguish among the seeds when they were harvested. The second discoid plant bloomed in 1981. The last second generation plant bloomed in 1983. None of the second generation radiate plants showed obvious reduction in the number of ray florets or in ray length.

Seeds harvested from the first discoid head in the second generation produced 62 third generation progeny which were maintained in the greenhouse. Of these, 31 proved to be radiate and 27 discoid

(four died without flowering). As in the second generation, none of the radiate progeny exhibited any obvious reduction in the number of ray florets, or in the length of the ligule in ray florets, such as that resulting from hybridization between normal radiate and mutant discoid heads in *Bidens*, *Layia*, or *Senecio*. This may indicate that no cross-pollination took place between discoid and radiate siblings, or that a different genetic mechanism is in effect from that in the other genera cited.

Most of the second and third generation plants were not significantly different in appearance from naturally occurring plants, but a few of the third generation plants had a striking columnar growth habit rather than the more typical sessile rosetted form. At the tip of a thick central axis up to 15 cm. long and 2 cm. thick they bore a terminal rosette of dark green leaves with darkly anthocyanous petioles which were reflexed at their bases, so that the leaves bent downward. The general appearance was that of a miniature "tree" composite.

Based on visual inspection alone leaf form among the third generation progeny is obviously variable. Most of the plants resemble var. *pinnatifidum* (var. *subpinnatifidum* of Fernald, 1903), although a few tend toward the typical variety. However, leaf form is too variable to allow attribution of all the plants to one variety or the other. In addition, chromosome counts of  $2n = 18$  were found in one radiate and one discoid plant of the third generation. Mulligan (1958) found var. *pinnatifidum* (as var. *subpinnatifidum*) to be diploid, with  $2n = 18$ , and var. *leucanthemum* to be tetraploid, with  $2n = 36$ . In this respect, the leaf form of the large majority of third generation plants would correspond with Mulligan's observations on the correlation of leaf form and chromosome number.

There is some indication that flowering time can differ, at least in the greenhouse, between the discoid and radiate siblings. The seeds from the second generation discoid plant were planted in the summer of 1978. The first three third generation plants to bloom in 1980 were discoid, with the discoid plants tending to flower earlier than the radiate siblings. In the late winter and spring of 1982-83, the discoid plants began to flower in late January and February, and practically all were in flower before the first of the radiate siblings began to flower. Both types then continued to flower through much of the summer, well beyond the normal flowering period in the field.

The recognition of the occurrence and inheritance of discoidy in *Chrysanthemum leucanthemum* may lead to a better understanding of some of the variation in the species. Seeds resulting from open- and self-pollinated third generation discoid and radiate plants are being grown to check variation in the fourth generation.

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